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Performance Indicators for Lean Construction in South Africa: Lessons from the Port Elizabeth province

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Abstract

This study sought to identify the Key Performance Indicators (KPIs) for monitoring the implementation performance of lean construction (LC) practices in South Africa. Given the limited penetration of the LC concepts and its associated tools in South Africa, an identification of how to measure progress among general contractors who are embracing practices akin to LC has become imperative. Relevant KPIs were extracted from conference proceedings published between 1996 and 2016 on the International Group for Lean Construction (IGLC) website using content analysis. Subsequently, a group of contractors, purposively selected as interviewees, were asked to identify KPIs being utilized by their organisations. Notable KPIs highlighted comprised mainly of the conventional ones like cost, time, quality, client satisfaction, minimal environment impact and improved value. It is worth noting that lean-specific KPIs were not observed from the thematically analyzed data. This realization reinforces the perception that LC practices are yet to make sufficientinroads into South Africa, andconventional KPIs are not adequate to indicate otherwise.

Keywords: performance indicator, lean construction, South Africa

1. Introduction

Construction project failures are being increasingly reported around the world. Instances of such failures appear to be prevalent in the developing countries, particularly in Africa. Countries within the continent are continually relying on the efficiency and effectiveness of the construction industry to deliver on its stride towards bridging the infrastructural deficit experienced within the continent. Furthermore, the attainment of construction project success not only within the continent but also across the globe has become difficult as a result of industry peculiarities such as its fragmented nature, etc. These peculiarities often lead to the occurrence of various types of waste. Accordingly, construction projects can be described as being vulnerable to wastes, hence denying clients the much sought after improvement of value (Al-Aomar, 2012). Suffice to say that construction activities across the globe have become synonymous with high levels of waste and Lean Construction has been identified a potent philosophy for curbing such wastes and resulting in optimal value creation for stakeholders (Bolviken and Koskela 2016). According to Arbulu and Zabelle (2006), considerable attention has been devoted

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by construction organisations towards the attainment of the benefits accruable from lean construction practices if properly adopted and implemented. Several case studies abound which attest to some of the proven benefits and pockets of excellence experienced within contexts where lean construction principles have been adopted either holistically or partially and implemented likewise (Alarcon et al., 2002; Swain and Mossman, 2003; Wu and Low, 2011; Andersen et al., 2012; Keiser, 2012).The lean philosophy appears not to have attracted all-round accolades as some unsuccessful projects have also been reported, the integration of lean practices, notwithstanding (Olatunji, 2008; Senaratne and Wijesiri, 2008; Abdullah et al., 2009; Mossman, 2009a).

Lean construction has been described as a management philosophy which seeks to be defined according to its pursuit of ideals such as waste elimination, cost reduction, mainstreaming of innovative practices, engagement of right skills mix and effective organisation within the workplace as well as methods utilised in the attainment of these ideals (Ballard, 2015). Significant advances have been recorded in the field of LC over the past decades. Challenges have been posed to extant production and project management theories resulting in the development and dissemination of new tools of lean construction to relevant stakeholders in the construction industry (Ballard 2000a; Ballard 2000b; Howell 1999; Koskela 2000). To buttress the growth of the LC literature, a substantial body of literature now exists especially from the archives of the International Group for Lean Construction (IGLC), a special interest group of academics and practitioners with interest in Lean Construction.

Despite the acknowledgment of successful implementation of LC practices in developed and emerging economies such as USA, UK, Australia, Brazil, Chile, Finland, Singapore, Peru, Ecuador, Indonesia and Columbia (Ballard and Howell, 2003), African countries seem not to have made appreciable progress in this wise. The case of South Africa is even more pertinent. A recent study conducted within the South African context reveal a low rate of LC awareness among industry stakeholders (Emuze and Ungerer, 2014). The inability of interested parties within the construction sector, in South Africa as well as the rest of the developing world, to measure the improvements brought about by the integration of LC practices remains a major obstacle to its adoption by these stakeholders. Accordingly, it becomes difficult to attract converts to this innovative approach in the absence of widely accepted performance indicators. This is partly due to the perception of relevant stakeholders of LC being largely conceptual. Questions about its meaning, processes for identifying where it has been applied, whether it implies achieving more with less as well as how much less actually qualifies as lean are continually being asked by interested parties. Obviously the construction industry in these climes requires an articulation of LC in a way that can easily be understood hence engendering its successful application (Ward 2015). Such an articulation would require the identification of widely accepted lean-centric KPIs for different stakeholders within the South African construction industry.

KPIs have been described as a means of improving the effectiveness and efficiency of construction projects. According to Yong and Mustaffa (2012), KPIs represent indicators which are “critical” to the success of the performance of a sector or organisation. They differ from organisation to organisation depending on contextual peculiarities such as their respective operation environment, policies and legal restrictions. But the most common KPIs available revolve around the generic items of cost, time and quality. However, concerning KPIs for LC implementation, Leigard and Personen (2010) observe that many case studies on LC implementation addressed implementation issues for a single project and not in a more holistic manner. This signals an inadequacy of extant KPIs for measuring effective LC implementation across a plethora of construction projects. This implies the elusive nature of the search for KPIs in the implementation of LC in construction project (Netland, 2015).

This is the gap which this study seeks to contribute towards bridging. However, the scope of this study will be limited to the contractors within the Port Elizabeth municipality of the Eastern Cape province of South Africa. The choice of contractors was premised on the centrality of their role to the attainment of project success or failure. This study stems from a proposition that an increased uptake of lean construction practices amongst contractors would lead to better project delivery outcomes. Admittedly, the identification of KPIs from the worldviews of these contractors would contribute to the development of a widely acceptable set of KPIs for LC implementation performance management within the South African Construction industry.

To achieve this salient objective, subsequent parts of this study will consist of: a brief review of the literature on performance measurement in construction and the integral nature of the KPIs therein; a justification of the research methodology adopted in the conduct of the study, a presentation and discussion of the findings, and the concluding remarks.

2. Performance Measurement in the Construction Industry

Performance is described as the valued productivity output of a system in the form of goods and services (reference is needed). The term 'performance' denotes the degree to which an organisation fulfills primary measures in order to meet the needs of its customers (reference is needed). Al-Aomar (2012) defines performance in competency terms as the behaviouralcompetencies deemed critical to the attainment of goals within project-based organisations. Franco-Santo, Lucianetti, and Bourne (2012) extend this definition by introducing the contemporary performance measurement system, which, for instance, consists of balance scorecards (BSC) and KPIs among others

An effective approach to selecting performance measures is the identification of the minimum set of measures which can enable effective judgments on the standards and extents of a particular process. The selection of performance measures should consider actions that reinforce the activities that are in the best interests of the organisation (Cha and Kim, 2011). Construction organisations should align the reasons for implementing a performance measurement system with the need to improve the overall effectiveness of its business processes. Accordingly, performance measurement can be described as involving the identification of a balanced set of measures for measuring what matters to service users and other stakeholders, involving staff in the determination of the measures and making sure that both perception measures and quantifiable performance indicators are included (Ofori, Teo and Tjandra, 2012).

2.1 Key performance indicators

According to Parmenter (2010), KPIs represent a set of measures focusing on those aspects of organisational performance that are most critical for the current and future success of the organisation. The KPIs reflect a balance between cost, quality and time. These indicators must be the critical and should be able to alert managers immediately if something goes wrong so that they can react to it. (Marx, 2013).

KPIs as applied in construction industry enables contractors to:(1) overcome uncertainty in contractor selection processes; (2) unify and standardize data collection processes surrounding KPIs; (3) enable greater clarity in contractor evaluation; (4) increase the quality of measurement and benchmarking processes; (5) provide essential pre-qualification measures for small to medium construction

organisation; (6) improve contractors' competitiveness, (7) improve the quality and performance of construction process; (8) increase levels of customer satisfaction; and (9) improve project management capabilities (Alkilani, Jupp and Sawhney, 2012).

3. Research Methodology

This study adopts a qualitative case study research design with emphasis on the collection of data in two distinct yet interrelated phases. A review of the conference and journal article publications spanning a 20-year period on databases of the International Group of Lean Construction (IGLC), Lean Construction Journal, Emerald, Taylor and Francis, Sage, Scopus, and Ebscohost was conducted, initially. The keywords/search terms utilized in searching for relevant studies across these databases consisted of the following; 'lean indicators, lean performance indicators, lean key performance indicators'. Searches were conducted between the 1st day of March, 2017 to the 24th day of March, 2017 by the authors. These databases were selected as a result of their proclivity towards hosting journal publications on innovations in the construction industry such as LC. After a thorough search across these databases, 45 articles and conference papers were extracted using content analysis based on the search terms used. It must be noted that due to the inability of the authors to gain full unrestricted access to the publications available on these databases contributed to the meagre number of publications obtained. This posed a major constraint to the authors. The authors then perused through these articles to identify the lean KPIs mentioned therein.

The second phase of the data collection exercise consisted of the conduct of interview sessions with a purposively selected group of contractors within Port Elizabeth. Port Elizabeth was chosen for this study due to convenience purposes. Interviews have been described as capable of letting the interviewer into the worldviews of interviewees. Also, the adoption of semi-structured interviews as a data elicitation technique for this study provided the researchers with the flexibility needed to alter the questioning patterns to suit the particular interviewee. In consideration of the need to explore the perceptions of contractors concerning KPIs for measuring LC implementation performance in construction projects, 12 CIDB grade 5 contracts managers were selected as interviewees. Leedy and Ormrod (2010:141) recognise that "a typical sample size ranges from between 5 to 25 individuals". These respondents were sent invitations to participate in the study and asked to signal their intention to participate in the study to the authors. Seven interviewees replied in the affirmative and were subsequently recruited. Reminders sent out to the remaining five prospective interviewees were not replied within the timeline provided.

Having relied on a review of the lean KPI related articles sourced from the abovementioned databases and content analysis, the authors had developed an understanding of what these lean-centric KPIs were. Armed with this knowledge, they proceeded to ascertain from the interviewees, the manner of KPIs they applied in the measurement of LC implementation performance on their projects. Interview sessions lasted for an average of 30 minutes each. With the permission of the interviewees, the interview sessions were recorded with the aid of a tape recorder and subsequently transcribed. The transcripts were then read severally in the bid to establish any patterns worthy of note. These transcripts were thematically analysed in accordance to the pre-set theme selected by the authors prior to the commencement of the interview sessions proper.

4. Presentation of Findings and Discussion

Based on the review of 45 articles and conference papers sourced from various databases, nine (9) broad KPIs for lean construction implementation were extracted using content analysis. The nine KPIs are presented in Table 1 below.

Table 2: Identified KPI's for lean implementation

	KPI	A brief description of the KPI	Source
1	Time	Construction time, the speed of construction and time variation.	Leong, Zakuan and Samon (2014); Marx (2013); Parmenter, 2010.
2	Cost	Tender sum, construction costs, costs due to variations and modifications.	Leong et al. (2014); Parmenter, (2010); Marx (2013).
3	Quality	The ability of the project to adhere to the setup specifications.	Leong et al. (2014); Parmenter, (2010); Marx (2013).
4	Health and safety	Fatalities, accidents and injuries	Marx (2013); Parmenter, (2010).
5	Client satisfaction	Completion on time	Al-Aomar (2012); Parmenter, (2010).
6	Environmental impact	Air emissions, noise, solid waste and water discharge.	Marx (2013); Al-Aomar (2012); Parmenter(2010)
7	Waste	Number of defects, rework, errors, and omissions, the number of change orders, safety costs, excess consumption.	Al-Aomar (2012); Parmenter, (2010).
8	Speed	Quick delivery, speedy construction.	Al-Aomar (2012); Parmenter, (2010)
9	Value	Added value, profit, financial achievement, owner satisfaction	Al-Aomar 2012

The identification of these KPIs for LC implementation performance provided the authors with an in-depth understanding of what such KPIs were. This understanding was imperative considering the novel nature of the concept within the South African construction industry context where the selected interviewees were integral players. Excerpts emanating from the interview transcripts were presented according to the pre-set themes selected by the authors at the outset of the data collection exercise. These pre-set themes consist of the following, namely: awareness of LC among the contractors; knowledge of performance measurement indices in construction; KPIs for Lean construction implementation performance.

The discussion of the findings from the interviews will be presented in line to these above-mentioned themes.

4.1 Awareness of lean construction

Undoubtedly, with reagard to awareness of LC concepts or practices among contractors, it can be stated that without any awareness of such concepts, contractors would not be interested in implementing them within their projects and as such, will not be able to provide any LC based KPIs. This notion prompted the interviewer in this instance to commence the interview sessions with questions relating to the level of awareness of the interviewees concerning LC practices in construction. Five of the interviewees indicated that they were not aware of LC and proceeded to request for a brief explanation of the concept. Conversely, whereas two of the interviewees posited that they were aware of the LC concept, such

awareness did not readily translate to adequate knowledge of the concept and the associated techniques for its application. Buttressing their level of awareness, they requested a brief explanation of the concept of lean construction and how it works. This request was acquiesced by the interviewer who carefully explained it to them. Following from the findings in this instance, it can be averred that there is a low rate of awareness among contractors in Port Elizabeth, South Africa, hence affirming the findings made by Emuze and Ungerer (2014) concerning the low level of awareness and uptake of the LC concept among relevant stakeholders within the South African construction industry. There is need for an improvement in the level of awareness regarding LC concepts in South Africa as such understanding/awareness has been on the rise in other parts of the world, developing and develop, alike (Raghvan, Kalidindi and Koshy, 2014). In furtherance to this, it was observed that the actual implementation of the lean concept in projects had not taken place in any significant manner in Port Elizabeth, South Africa (Cerveró-Romero, Napolitano, Reyes and Teran, 2013).

4.2 Identifying KPIs

During the interview sessions, the interviewees were asked to identify the key performance indicators / KPIs used for measuring lean implementation performance in construction projects. Since all contractors did not implement lean, they could not identify KPIs for lean construction in their projects and organisation. The contractors had some idea of what the KPIs were but still required a brief explanation about the KPIs being sought for by the interviewer. There was a consensus among the interviewees on the nature of cost, time and quality and health and safety (H&S) as KPIs which they adopt during project implementation for measuring implementation performance. Four contractors mentioned health and safety and the environmental impact as KPIs. These findings correspond with those emanating from studies carried out by Marx (2013); Chan and Ada (2004) and Enshassi et al. (2012). These scholars posit that cost, time and quality are the three basic and most important performance indicators in construction projects, followed by others such as safety and client satisfaction. The study reflects that most of the KPIs in the selected organisations are adopted as a policy matter and not based on benefits or gains. Those practices which are being stipulated under some policy guidelines are being practised whereas those practices which are not specified to be implemented are mostly left to the choice of practitioner. This showed that even though contractors used KPIs, they were not aware of its impact on the performance management system.

5. Conclusion

The adoption of LC practices in the delivery of construction projects has been described severally as a panacea for curbing the imbroglio of project failure across the globe. A plethora of evidence abounds to attest to this notion. South Africa has continued to grapple with the increasing incidences of failed construction projects, signalling the need for a change in the contemporary mode of project delivery in the country. Proponents of LC have continued to advocate for its adoption and integration within the local construction industry, highlighting as it were the immense benefits accruable from the proper application of the concept especially as it pertains to waste elimination, cost reduction, timely delivery and superb quality which conforms to the tenets of sustainable development.

The inability of relevant stakeholders to develop and maintain KPIs for the measurement of LC implementation performance on projects has been identified as a challenge to the holistic

adoption of the principle in several construction industries like South Africa. The absence of a widely accepted set of LC based KPIs within the context further exacerbates this imbroglio and thus, has prompted this study. The study sought to identify the KPIs for LC implementation performance which are peculiar to the South African Construction industry context. It relied on the use of relevant publication databases and semi-structured interviews. However, the bid to make a significant contribution to the on-going discourse over the mainstreaming of LC practices into every facet of the construction project was controverted by the low level of awareness among contractors in the study area concerning LC practices. As a result of this, contractors interviewed were not able to distinguish between the conventional KPIs for measuring project performance and KPIs for measuring LC implementation performance. This observation highlights the need for more awareness to be created by stakeholders in bringing about such change.

Summarily, it is expected that findings from this study will contribute to the emerging discourse on KPIs for LC implementation performance in the South African construction industry as well draw attention of government-the major client- to improve the level of awareness pertaining to LC integration.

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